I CLAIM:

1. A waveguide for shifting the phase of a signal transmitted through it, comprising:

a waveguide; and

at least one pair of opposing impedance wall structures on said waveguide that establish an impedance to signals at a resonant frequency of said waveguide and a higher impedance to signals having a frequency higher than said resonant freq, said wall structures presenting a primarily capacitive impedance to higher frequencies to shift its phase.

Sub A16

2. The waveguide of claim 1, wherein said wall structures present high impedance resonant L-C circuits to a resonant frequency, and a primarily capacitive impedance to a signal having a frequency higher than said resonant frequency.

3. The waveguide of claim 1, wherein said wall structures present a high impedance to a signal at a resonant frequency which has an E field transverse to the waveguide axis and parallel to the wall structures, and a primarily capacitive impedance to a signal having a frequency higher than said resonant frequency.

Sp I

4. The waveguide of claim 3, wherein each of said impedance wall structures comprises:

a substrate of dielectric material having two sides;

a conductive layer on one side of said dielectric material;

a plurality of mutually spaced conductive strips on the other side of said dielectric material, said strips separated by gaps and positioned parallel to said

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waveguide's longitudinal axis; and

a plurality of conductive vias extending through said dielectric material between said conductive layer and said conductive strips.

4 ~~5.~~ The waveguide of claim ~~4,~~ 12 wherein adjacent pairs of said strips present a capacitance and said dielectric substrate presents an inductance to said resonant frequency signal having an E field transverse to said conductive strips.

6. The waveguide of claim 5, wherein said conductive strips and dielectric substrate form a series of L-C circuits to said resonant frequency signal having an E field transverse to said conductive strips.

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7. The waveguide of claim 4, wherein said conductive strips and said dielectric substrate present a capacitive impedance to a waveguide signal having an E field transverse to said conductive strips.

Sp II

8. The waveguide of claim 1, wherein said impedance wall structures establish a resonant frequency for said waveguide, further comprising an adjustable circuit element connected to said waveguide to adjust said resonant frequency.

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9. The waveguide of claim 8, wherein each of said impedance wall structures comprises:

a substrate of dielectric material having two sides;

a conductive layer on one side of said dielectric material;

a plurality of mutually spaced conductive strips on

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the other side of said dielectric material, said strips being separated by gaps and positioned parallel to said waveguides longitudinal axis;

a variable capacitance across each said gap; and

a plurality of conductive vias extending through said dielectric material between said conductive layer and said conductive strips.

10. The waveguide of claim 9, wherein changes in said variable capacitance changes the frequency at which said impedance structure presents a high impedance.

11. The waveguide of claim 10, wherein said variable capacitance comprises a varactor diode having a voltage dependant capacitance.

12. The waveguide of claim 11, wherein the capacitance of said diode varies inversely with the voltage across it.

13. The waveguide of claim 9, wherein adjacent pairs of said strips, said variable capacitance, and said dielectric substrate present a series of high impedance resonant L-C circuits to a signal at resonant frequency of said waveguide.

14. The waveguide of claim 9, wherein said conductive strips, said variable capacitance, and said dielectric substrate present a primarily capacitive impedance to signal at a frequency higher that said resonant frequency.

15. The waveguide of claim 9, further comprising a array amplifier positioned within said waveguide to amplify the signal passing through it.

16. The waveguide of claim 15, wherein said array amplifier positioned within the waveguide to amplify said waveguide signal after its phase has been shifted.

17. The waveguide of claim 16, further comprising:

a first impedance transition region between the entry to said waveguides and said wall structures, said first region transitioning from a resonant frequency higher than said structure's resonant frequency at said entry, to a resonant frequency substantially equal to said wall structure resonant frequency at said wall structure; and

a second impedance transition region downstream from said impedance structures, said second region transitioning from a resonant frequency at said wall structures substantially equal to the wall structure resonant frequency to a higher exit resonant frequency downstream from said wall structures.

18. The waveguide of claim 17, further comprising an amplifier impedance region downstream from said second impedance region and housing an amplifier array, said amplifier impedance region having a resonant frequency substantially equal to said second impedance transition region's exit resonant frequency.

Sp IV

19. A module for phase shifting or beam steering an electromagnetic beam, comprising:

a plurality of waveguides adapted to receive at least a portion of an electromagnetic beam, said waveguides being adjacent to one another with their longitudinal axes aligned with the propagation of said beam, each of said waveguides having a phase shifting section to cause a shift

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in the phase of their respective portions of said beam.

20. The module of claim 19, wherein each of said waveguides causes the same shift in its respective portion of said electromagnetic beam.

21. The module of claim 19, wherein each said waveguide comprises:

a resp waveguide; and

at least one pair of opposing impedance wall structures on said resp waveguide that establish an impedance to signals at a resonant frequency of said waveguide and a higher impedance to signals having a frequency higher than said resonant freq, said wall structures presenting a primarily capacitive impedance to higher frequencies to shift its phase.

22. The module of claim 21, wherein said wall structures present high impedance resonant L-C circuits to a resonant frequency, and a primarily capacitive impedance to a signal having a frequency higher than said resonant frequency.

23. The waveguide of claim 21, wherein said wall structures present a high impedance to a signal at a resonant frequency which has an E field transverse to the waveguide axis and parallel to the wall structures, and a primarily capacitive impedance to a signal having a frequency higher than said resonant frequency.

24. The module of claim 21, wherein each said impedance wall structure comprises:

a substrate of dielectric material having two sides;

a conductive layer on one side of said dielectric

material;

a plurality of mutually spaced conductive strips on the other side of said dielectric material, said strips being separated by gaps and positioned parallel to said waveguides longitudinal axis; and

a plurality of conductive vias extending through said dielectric material between said conductive layer and said conductive strips.

25. The module of claim 19, wherein each of said waveguides causes different shifts in its respective portion of said electromagnetic beam to steer the beam passing through said module.

26. The module of claim 25, wherein said impedance wall structures establish a resonant frequency for said waveguide, further comprising an adjustable circuit element connected to said waveguide to adjust said resonant frequency.

27. The module of claim 31, wherein each said impedance wall structure comprises:

a substrate of dielectric material having two sides;

a conductive layer on one side of said dielectric material;

a plurality of mutually spaced conductive strips on the other side of said dielectric material, said strips being separated by gaps and positioned parallel to said waveguides longitudinal axis;

a variable capacitance across each said gap; and

a plurality of conductive vias extending through said dielectric material between said conductive layer and said conductive strips.

28. The module of claim 27, wherein changes in said variable capacitance changes the frequency at which said impedance structure presents a high impedance.

29. The module of claim 32. wherein said variable capacitance comprises a varactor diode having a voltage dependent capacitance, the capacitance of said diode varies inversely with the voltage across it.

30. The waveguide of claim 19, further comprising an array amplifier positioned within each of said waveguides to amplify said beam portion passing through each respective said waveguide.